

780 CMR 3606

WALL CONSTRUCTION

780 CMR 3606.1 GENERAL

**3606.1.1 Application:** The provisions of 780 CMR 3606.1 shall control the design and construction of all walls and partitions for all buildings. The use of materials or methods of construction not specified in this chapter accomplishing the purposes intended by 780 CMR 36 and approved by the building official in accordance with **780 CMR 109.0** shall be accepted as complying with 780 CMR 36.

**3606.1.2 Requirements:** The wall construction shall be capable of accommodating all loads imposed according to **780 CMR 3603.1** and transmitting the resulting loads to supporting structural elements.

**3606.1.2.1 Floor-covering materials:** *Interior and exterior bearing and non-loadbearing walls shall be placed directly on floor sheathing, underlayment or a structural framing member, fastened in accordance with Table 3606.2.3a.* Compressible floor-covering materials that compress more than  $\frac{1}{32}$  inch (0.794 mm) when subjected to 50 pounds (23 kg) applied over one square inch (645 mm) of material and are greater than  $\frac{1}{8}$  inch (3.2 mm) in thickness in the uncompressed state shall not extend beneath walls, partitions or columns which are fastened to the floor.

780 CMR 3606.2 WALL FRAMING

**3606.2.1 Identification:** Load-bearing dimension lumber used for studs, plates and headers shall conform to DOC PS 20, *as listed in Appendix A*, and to other applicable standards and grading rules and shall be identified by a grade mark, or certificate of inspection issued by an approved agency. The grade mark or certificate shall provide adequate information to determine the " $F_b$ " the allowable stress in bending, and " $E$ ," the modulus of elasticity. Approved end-jointed lumber may be used interchangeably with solid-sawn members of the same species and grade.

**Exception:** *Native Lumber as identified in 780 CMR 2303.2 and 780 CMR R4.*

**3606.2.2 Grade:** Studs shall be a minimum No. 3, Standard or Stud grade lumber.

**Exception:** Bearing studs not supporting floors and nonbearing studs may be Utility grade

lumber, provided the studs are spaced in accordance with Table 3606.2.3d.

**3606.2.3 Exterior Walls:** Exterior walls of wood-frame construction shall be designed and constructed in accordance with the provisions of 780 CMR 3606.2 and *Figures 3606.2.3a and 3606.2.3b*. Components of exterior walls shall be fastened in accordance with *Tables 3606.2.3a through 3606.2.3d*.

**3606.2.3.1 Special provisions for high wind loads:** Exterior walls subject to wind pressures of 30 pounds per square foot ( $1.44 \text{ kN/m}^2$ ) or greater, as established *by wind load maps, 780 CMR 1611.1a, b and c*, shall be designed in accordance with accepted engineering practice.

**3606.2.3.2 Stud spacing:** In bearing walls, studs which are not more than ten feet (3048 mm) in length shall be spaced not more than is specified in *Table 3606.2.3d* for the corresponding stud size.

**3606.2.3.3 Top plate:** Exterior wall studs shall be capped with a double top plate installed to provide overlapping at corners and intersections with bearing partitions. End joints in top plates shall be offset at least 48 inches (1219 mm).

**Exception:** A single top plate may be installed in bearing and exterior walls, provided the plate is adequately tied at joints, corners and intersecting walls with three-inch-by-six-inch by a 0.036-inch-thick (76 mm by 153 mm by 0.914 mm) galvanized steel plate that is nailed to each wall or segment of wall by three 8d nails, provided the rafters or joists are centered over the studs with a tolerance of no more than one inch (25 mm). The top plate may be omitted over lintels which are adequately tied to adjacent wall sections with steel plates or equivalent as previously described.

**3606.2.3.4 Bearing studs:** Where floor or roof framing members are spaced more than 16 inches (406 mm) on center and the bearing studs are spaced 24 inches (610 mm) on center, such members shall bear within five inches (127 mm) of the *bearing studs*.

**Exceptions:**

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1.

The top plates are two two-inch-by-six-inch (51 mm by 153 mm) or two three-inch-by-four-inch (76 mm by 102 mm) members.
2.

A third top plate is installed.
3.

Solid blocking equal in size to the studs is installed to reinforce the double top plate.

**3606.2.4.1 Interior nonbearing partitions:** Interior nonbearing partitions may be constructed with two-inch-by-three-inch (51 mm by 76 mm) studs spaced 24 inches (610 mm) on center or two-inch-by-four-inch (51 mm by 102 mm) flat studs spaced 16 inches (406 mm) on center. Interior nonbearing partitions may be capped with a single top plate.

**3606.2.5 Drilling and notching-studs:** Any stud in an exterior wall or bearing partition may be cut or notched to a depth not exceeding 25% of its width. Studs in nonbearing partitions may be notched to a depth not to exceed 40% of a single stud width. Any

**3606.2.4 Interior load-bearing partitions:** Interior load-bearing partitions shall be constructed, framed and firestopped as specified for exterior walls.

stud may be bored or drilled, provided that the diameter of the resulting hole is no greater than 40% of the stud width, the edge of the hole is no closer than    inch (15.9 mm) to the edge of the stud, and the hole is not located in the same section as a cut or notch.

**Exception:** A stud may be bored to a diameter not exceeding 60% of its width, provided that such studs when located in exterior walls or bearing partitions are doubled and that not more than two successive studs are bored.

TABLE 3606.2.3a  
FASTENER SCHEDULE FOR  
STRUCTURAL MEMBERS

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENERS <sup>1,2,3,4</sup>	SPACING OF FASTENERS
Joist to sill or girder, toe nail	3-8d	-
1" x 6" subfloor or less to each joist, face nail	2-8d 2 staples, 1¾"	- -
2" subfloor to joist to girder, blind and face nail	2-16d	-
Sole plate to joist or blocking, face nail	16d	16d" o.c.
Top or sole plate to stud, end nail	2-16d	-
Stud to sole plate, toe nail	3-8d or 2-16d	-
Double studs, face nail	10d	24" o.c.
Double top plates, face nail	10d	24" o.c.
Double top plates, minimum 48-inch offset of end to joints, face nail in lapped area	4-10d	-
Top plates, laps at corners and intersections, face nail	2-10d	-
Built-up header, two pieces with ½" spacer	16d	16" o.c. along each edge
Continued header, two pieces	16d	16" o.c. along each edge
Ceiling joists to plate, toe plate	3-8d	-
Continuous header to stud, toe nail	4-8d	-
Ceiling joist, laps over partitions, face nail	3-10d	-
Ceiling joist to parallel rafters, face nail	3-10d	-
Rafter to plate, toe nail	2-16d	-
1" brace to each stud and plate, face nail	2-8d 2 staples, 1¾"	- -
1" x 6" sheathing to each bearing, face nail	2-8d 2 staples, 1¾"	- -
1" x 8" sheathing to each bearing, face nail	3-8d 3 staples, 1¾"	- -
Wider than 1" x 8" sheathing to each bearing, face nail	3-8d 4 staples, 1¾"	- -
Built up corner studs	10d	24" o.c.
Built-up girders and beams, 2-inch lumber layers	10d	Nail each layer as follows: 32: o.c. at top and bottom and staggered. Two nails at ends and at each splice.
2" planks	2-16d	At each bearing
Roof Rafters to ridge, valley or hip rafters:	4-16d	-
toe nail	3-16d	-
face nail		
Rafter ties to rafters, face	3/8d	-

780 CMR: STATE BOARD OF BUILDING REGULATIONS AND STANDARDS

ONE AND TWO FAMILY DWELLINGS - WALL CONSTRUCTION

DESCRIPTION OF BUILDING MATERIALS	DESCRIPTION OF FASTENER <sup>2,3,4,5</sup>	SPACING OF FASTENERS	
		Edges (inches)	Intermediate Supports <sup>3,5</sup> (inches)
Plywood and wood structural panels, subfloor, roof and wall sheathing to framing, and particleboard wall sheathing to framing			
<sup>5</sup> / <sub>16</sub> " - <sup>1</sup> / <sub>2</sub> "	6d common nail (subfloor, wall) 8d common nail (roof) <sup>6</sup>	6	12 <sup>7</sup>
<sup>19</sup> / <sub>32</sub> " - 1"	8d common nail	6	12 <sup>7</sup>
1 _" - 1¼"	10d common nail or 8d deformed nail	6	12
Other wall sheathing <sup>8</sup>			
½" gypsum sheathing	1½" galvanized roofing nail; 6d common nail; staple galvanized, 1½" long; 1¼" screws, Type W or S	4	8
_ " gypsum sheathing	1¾" galvanized roofing nail; 8d common nail; Staple galvanized, 1 _" long, 1 _" screws, Type W or S	4	8
Plywood and wood structural panels, combination subfloor underlayment to framing			
¾" and less	6d deformed nail, or 8d common nail	6	12
_ " - 1"	8d common nail or 8d deformed nail	6	12
1 _" - 1¼"	10d common nail or 8d deformed nail	6	12

- For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mph = 1.609 km/h.
1. All nails are smooth-common, box or deformed shanks except where otherwise stated.
  2. Staples are 16 gauge wire and have a minimum <sup>7</sup>/<sub>16</sub>-inch O.D. crown width.
  3. Nails shall be spaced not more than six inches o.c. at all supports where spans are 48 inches or greater.
  4. Four-foot by eight-foot or four-foot-by-nine-foot panels shall be applied vertically.
  5. Spacing of fasteners not included in this table shall be based on Table 3606.2.3a(1).
  6. For regions having basic wind speed of 90 mph or greater, 8d deformed nails shall be used for attaching plywood and wood structural panel roof sheathing to framing within minimum 48-inch distance from gable end walls, if mean roof height is more than 24 feet, up to 35 feet maximum.
  7. For regions having basic wind speed of 80 mph or less, nails for attaching plywood and wood structural panel roof sheathing to gable end wall framing shall be spaced six inches o.c. When basic wind speed is greater than 80 mph, nails for attaching panel roof sheathing to intermediate supports shall be spaced six inches o.c. for minimum 48-inch distance from ridges, eaves and gable end walls; and four inches o.c. to gable end wall framing.
  8. Gypsum sheathing shall conform to ASTM C 79 and shall be installed in accordance with GA 253. Fiberboard sheathing shall conform to either AHA 194.1 or ASTM C 208.

TABLE 3606.2.3a(1)  
ALTERNATE ATTACHMENTS

NOMINAL MATERIAL THICKNESS	DESCRIPTION <sup>1,2</sup> OF FASTENER AND LENGTH	SPACING <sup>3</sup> OF FASTENERS	
		Edges (inches)	Intermediate Supports (inches)
Plywood and wood structural panels subfloor, roof and wall sheathing to framing and particleboard wall sheathing to framing			
<sup>5</sup> / <sub>16</sub> "	0.097 -0.099 Nail 1½" Staple 15 ga 1 _"	6	12
_"	Staple 15 ga 1 _" 0.097 -0.099 Nail 1½"	6 4	12 10
	Staple 15 ga 1½" 0.097 -0.099 Nail 1 _"	6 3	12 6
<sup>15</sup> / <sub>32</sub> " and ½"	0.113 Nail 1 _" Staple 15 and 16 ga. 1 _"	6	12
	0.097 -0.099 Nail 1¾"	3	6
<sup>19</sup> / <sub>32</sub> " and _"	Staple 14 ga. 1¾" Staple 15 ga. 1¾"	6 5	12 10
	0.097 -0.099 Nail 1 _"	3	6
<sup>23</sup> / <sub>32</sub> " and ¾"	Staple 14 ga. 2"	5	10

0.113 Nail 2 1/4"

4

8

NOMINAL MATERIAL THICKNESS	DESCRIPTION <sup>1,2</sup> OF FASTENER AND LENGTH	SPACING <sup>3</sup> OF FASTENERS	
		Edges (inches)	Intermediate Supports (inches)
	Staple 15 ga. 2"		
	0.097 -0.099 Nail 2_"	3	6
Floor underlayment; plywood-hardboard-particleboard		Edges (inches)	Body of Panel <sup>4</sup>
Plywood			
1/4" and 5/16"	1 1/4" ring or screw shank nail - minimum 12 1/2 ga. (0.099") shank diameter	6	8
11/32", and _,"15/32" and 1/2"	1 1/4" ring or screw shank nail - minimum 12 1/2 ga. (0.099") shank diameter	6	8 <sup>5</sup>
19/32", and _", 23/32" and 3/4"	1 1/2" ring or screw shank nail - minimum 12 1/2 ga. (0.099") shank diameter	6	12
NOMINAL MATERIAL THICKNESS	DESCRIPTION <sup>1,2</sup> OF FASTENER AND LENGTH	SPACING <sup>3</sup> OF FASTENERS	
		Edges (inches)	Body of Panel <sup>4</sup>
Hardboard 0.200"	1 1/2" long ring-grooved underlayment nail	6	6
	4d cement-coated sinker nail	6	6
	Staple 18 ga. _" long (plastic coated)	3	6
Particleboard 1/4"	4d ring-grooved underlayment nail	3	6
	Staple 18 ga. _" long 3/16" crown	3	6
_"	6d ring-grooved underlayment nail	6	10
	Staple 16 ga. 1 _" long _" crown	3	6
1/2" - _"	6d ring-grooved underlayment nail	6	10
	Staple 16 ga. 1 _" long _" crown	3	6

- For SI: 1 inch = 25.4 mm.
- Nail is a general description and may be T-head, modified round head, or round head.
  - Staples shall have a minimum crown width of 7/16-inch o.d. except as noted.
  - Nails or staples shall be spaced at not more than six inches o.c. at all supports where spans are 48 inches or greater. Nails or staples shall be spaced at not more than ten inches o.c. at intermediate supports for floors.
  - Fasteners shall be placed in a grid pattern throughout the body of the panel.
  - For 5-ply panels, intermediate nails shall be spaced not more than 12 inches o.c. each way.

TABLE 3606.2.3b

ALLOWABLE STUD SPACING FOR WOOD STRUCTURAL PANEL WALL SHEATHING

PANEL SPAN RATING	PANEL NOMINAL THICKNESS (inch)	MAXIMUM STUD SPACING (inches)	
		Siding Nailed to: <sup>1</sup>	
		Stud	Sheathing
12/0 16/0, 20/0, or Wall - 16 o.c.	5/16, 1/2	16	16 <sup>2</sup>
24/0, 24/16, 32/16 or Wall - 24 o.c.	1/2, 7/16, 15/32, 1/2	24	24 <sup>3</sup>

- For SI: 1 inch = 25.4 mm.
- Blocking of horizontal joints shall not be required.
  - Plywood sheathing 1/2-inch thick or less shall be applied with long dimension across studs.
  - Three-ply plywood panels shall be applied with long dimension across studs.

TABLE 3606.2.3c

ALLOWABLE SPANS FOR PARTICLEBOARD WALL SHEATHING<sup>1</sup>

THICKNESS (inches)	GRADE	STUD SPACING (inches)	
		When Siding is nailed to Studs	When Siding is Nailed to Sheathing
1/2	M-1 Exterior Glue	16	-
1/2	M-2 Exterior Glue	16	16

For SI: 1 inch = 25.4 mm.

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1. Wall sheathing not exposed to the weather. If the panels are applied horizontally, the end joints of the panels shall be offset so that four panels corners will not meet. All panel edges must be supported. Leave a <sup>1</sup>/<sub>16</sub>-inch gap between panels and nail to no closer than    inch from panel edges.

TABLE 3606.2.3d  
MAXIMUM STUD SPACING (inches)

STUD SIZE	SUPPORTING ROOF AND CEILING ONLY	SUPPORTING ONE FLOOR ROOF AND CEILING	SUPPORTING TWO FLOORS ROOF AND CEILING	SUPPORTING ONE FLOOR ONLY
2 x 4	24 <sup>1</sup>	16	-	24 <sup>1</sup>
3 x 4	24 <sup>1</sup>	24	16	24
2 x 5	24	24	-	24
2 x 6	24	24	16	24

For SI: 1 inch = 25.4 mm.

1 Shall be reduced to 16 inches if Utility grade studs are used.

3606.2.5.1 Drilling and notching-top plate:

When piping or ductwork is placed in or partly in an exterior wall or interior load-bearing wall, necessitating a cutting of the top plate by more

3606.2.6 Headers: The allowable spans for nominal four-inch thick (102 mm) single headers and two-inch thick (51 mm) double headers in bearing walls shall not exceed the spans set forth in Table 3606.2.6. The table shall not be used where concentrated loads are supported by the headers.

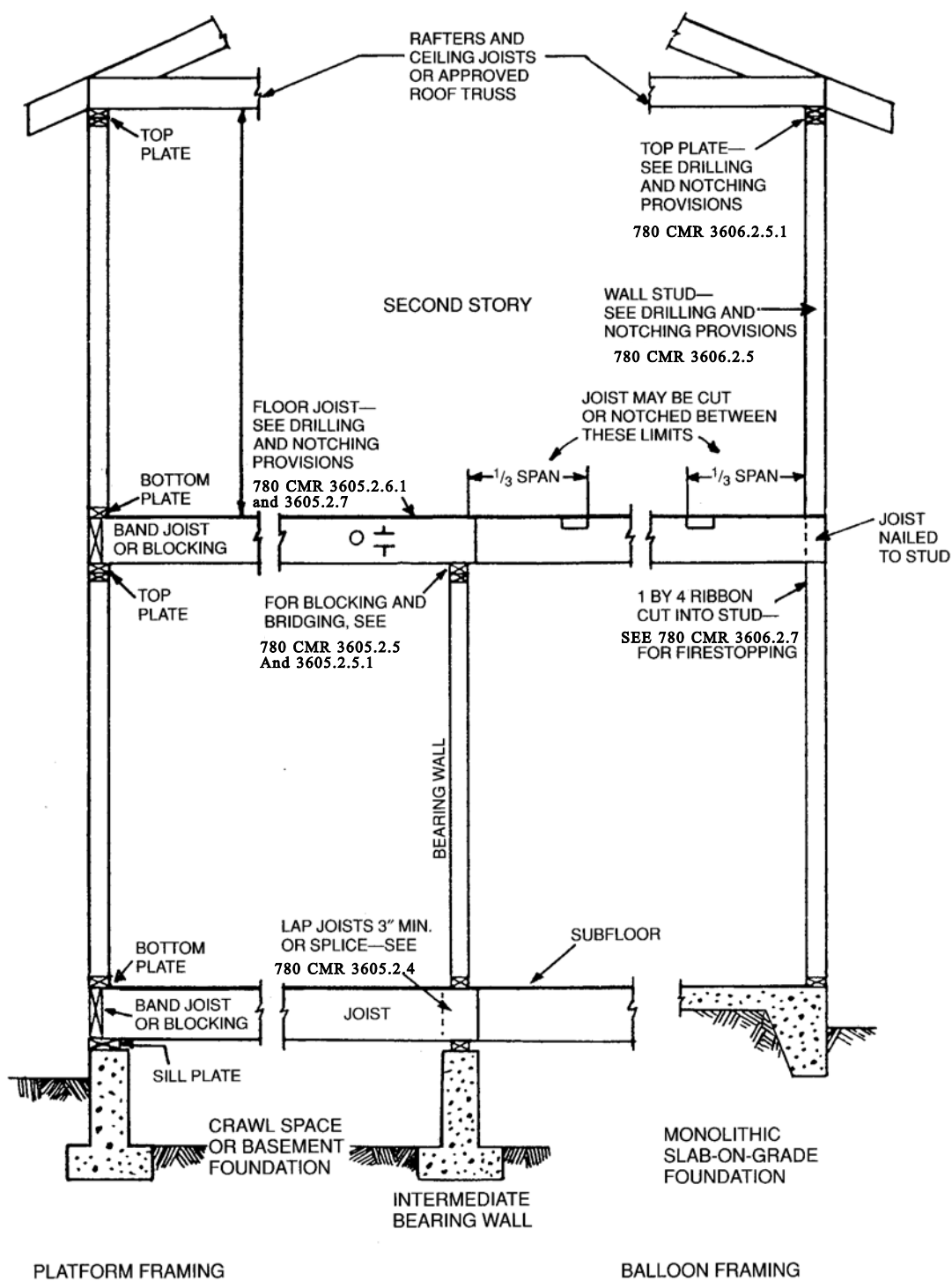
3606.2.6.1 Single headers: Nominal two-inch thick (51 mm) single headers *shall not be used in* load-bearing walls.

3606.2.6.2 Plywood box headers: Plywood box headers shall be constructed in accordance with Figure 3606.2.6.2 and Table 3606.2.6.2.

than 50% of its width, the plate shall be reinforced *to provide equivalent strength.*

3606.2.6.3 Non-bearing walls: Load-bearing headers are not required in interior or exterior nonbearing walls. A single flat two-inch-by-four-inch (51 mm by 102 mm) member may be used as a header in interior or exterior nonbearing walls for openings up to eight feet (2438 mm) in width if the vertical distance to the parallel nailing surface above is not more than 24 inches (610 mm). *Cripple spacing shall be the same as spacing of studs.*

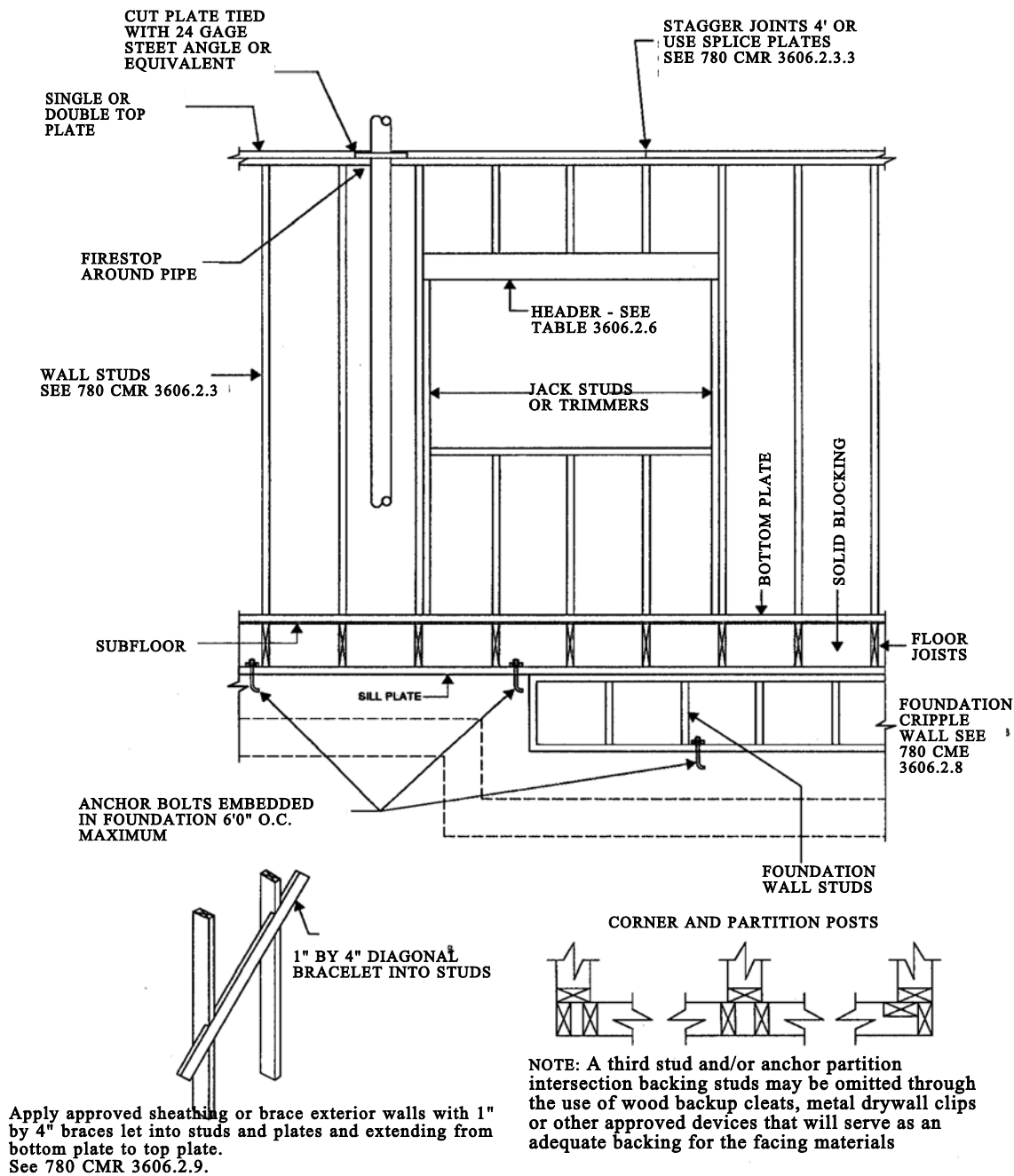
FIGURE 3606.2.3a  
TYPICAL WALL, FLOOR AND ROOF FRAMING



NOTE: See Figure 3604.3.1a for other foundation types

For SI: 1 inch = 25.4 mm.

FIGURE 3606.2.3b  
FRAMING DETAILS



For SI: 1 inch = 25.4 mm, 1 foot = 204.8 mm.

TABLE 3606.2.6  
MAXIMUM SPANS FOR HEADERS LOCATED OVER OPENINGS IN WALLS

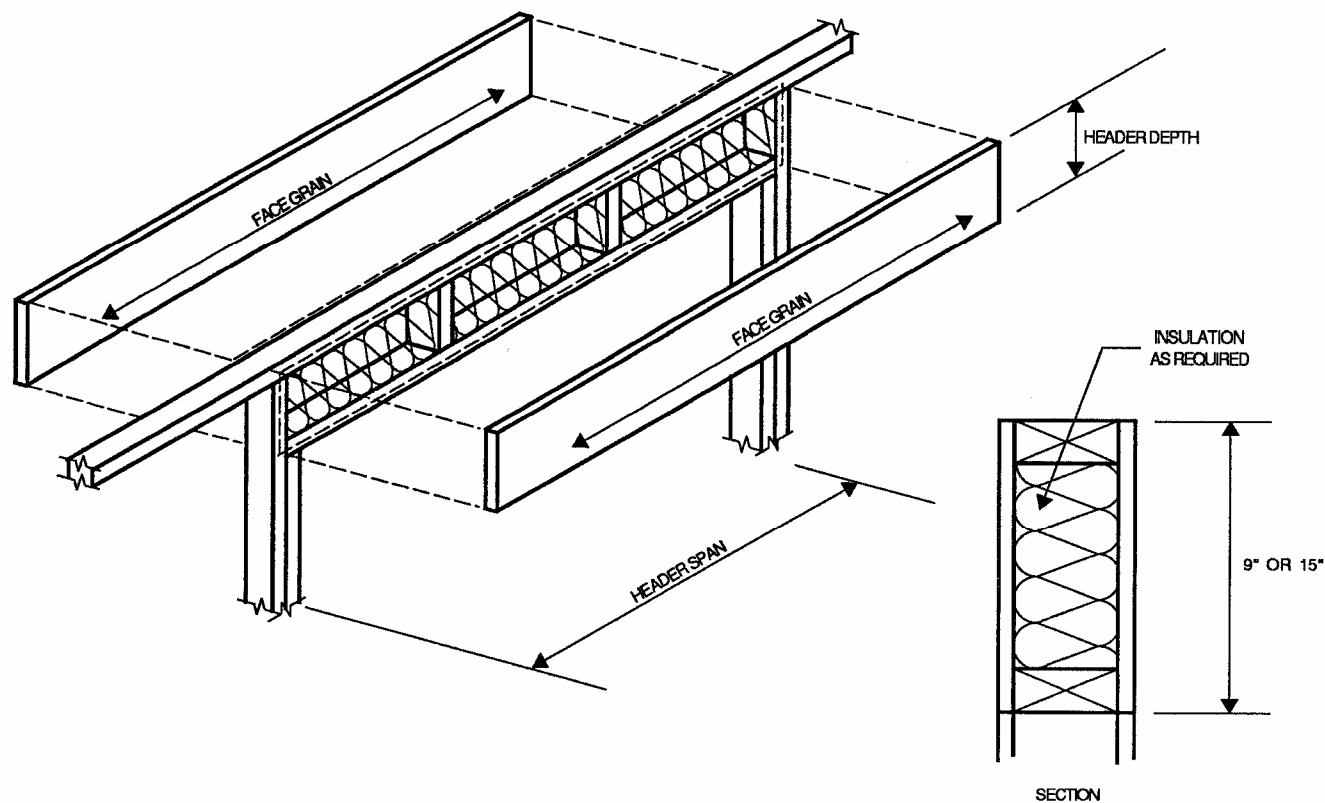
SIZE OF HEADER <sup>1,2</sup>	HEADERS IN BEARING WALLS <sup>2</sup>			HEADERS IN WALLS NOT SUPPORTING FLOORS OR ROOFS
	Supporting Roof Only	One Story Above	Two Stories Above	
2 - 2 x 4	4	-	-	-
2 - 2 x 6	6	4	-	-
2 - 2 x 8	8	6	-	10
2 - 2 x 10	10	8	6	12
2 - 2 x 12	12	10	8	16

For SI: 1 inch = 25.4 mm, 1 foot 304.8 mm.

1. Nominal four-inch thick single headers may be substituted for double members.

2. Spans are based on No. 2 Grade Lumber with ten-foot tributary floor and roof loads.

FIGURE 3606.2.6.2  
TYPICAL PLYWOOD BOX HEADER CONSTRUCTION



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

- 1 The top plate shall be continuous over header.
- 2 Jack studs shall be used for spans over four feet.
- 3 Cripple spacing shall be the same as for studs.
- 4 Plywood faces shall be single pieces of <sup>15</sup>/<sub>32</sub>-inch-thick C-D (exterior glue) or better, installed on the interior or exterior or both sides of the header.
- 5 Plywood faces shall be nailed to framing and cripples with 8d common nails spaced three inches o.c. staggering alternate nails ½ inch.

TABLE 3606.2.6.2  
MAXIMUM SPANS FOR PLYWOOD BOX  
HEADERS (feet)<sup>1</sup>

HEADER CONSTRUCTION <sup>2</sup>	HEADER DEPTH (inches)	HOUSE DEPTH (feet)				
		24	26	28	30	32
Plywood One Side	9	4	4	3	3	-
	15	5	5	4	3	3
Plywood Both Sides	9	7	5	5	4	3
	15	8	8	7	7	6

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

- 1 Spans are based on single story with clear-span trussed roof or two story with floor and roof supported by interior-bearing walls.
- 2 See Figure 3606.2.6.2 for construction details.

**3606.2.7 Firestopping:** Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective fire barrier between stories, and between a top story and the roof space. Firestopping shall be provided in wood-frame construction in the following locations.

- 1 In concealed spaces of stud walls and partitions, including furred spaces, at the ceiling and floor level;
- 2 At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings, etc.;

- 3 In concealed spaces between stair stringers at the top and bottom of the run;
- 4 At openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor level, with noncombustible materials.

**3606.2.7.1 Materials:** Except as provided in 780 CMR 3606.2.7 item 4, fire-stopping shall consist of two-inch (51 mm) nominal lumber, or two thicknesses of one-inch (25 mm) nominal lumber with broken lap joints, or one thickness of <sup>23</sup>/<sub>32</sub>-inch (18 mm) wood structural panels with joints backed by <sup>23</sup>/<sub>32</sub>-inch (18 mm) wood structural panels or one thickness of ¾-inch (19 mm) particleboard with joints backed by ¾-inch (19 mm) particleboard, ½-inch (12.7 mm) gypsum board, or ¼-inch (6.4 mm) cement-based mill-board

**3606.2.7.1.1 Unfaced fiberglass:** Unfaced fiberglass bat insulation used as firestopping shall fill the entire cross section of the wall cavity to a minimum height of 16 inches (406 mm) measured vertically. When piping, conduit or similar obstructions are encountered, the insulation shall be packed tightly around the obstruction.



**3606.2.8 Cripple walls:** Foundation cripple walls shall be framed of studs not less in size than the studs supported. When exceeding four feet (1219 mm) in height, such walls shall be framed of studs having the size required for an additional story.

**3606.2.8.1 Bracing:** Such walls having a stud height exceeding 14 inches (356 mm) shall be considered to be first story walls for the purpose of determining the bracing required by 780 CMR 3606.2.9. Stud walls less than 14 inches (356 mm) in height shall be sheathed with plywood or wood structural panels attached to both the top and bottom plates in accordance with Table 3606.2.3a, or the walls shall be constructed of solid blocking.

**3606.2.9 Wall bracing:** Exterior and foundation wall panels of frame construction shall be braced with one-inch-by-four-inch (25 mm by 102 mm) let-in braces, or approved metal strap devices installed in accordance with the manufacturer's specifications; wood structural panels in accordance with Table 3606.2.3b; particleboard in accordance with Table 3606.2.3c, gypsum sheathing, wallboard or veneer base applied vertically or horizontally to studs spaced not more than 24 inches (610 mm) on center and fastened in accordance with Table 3606.2.3a; fiberboard sheathing applied vertically to studs spaced not more than 16 inches (406 mm) on center and fastened in accordance with Table 3606.2.3a; portland cement plaster applied over metal lath attached to studs spaced not more than 16 inches (406 mm) on center in accordance with 780 CMR 3607.3.6, or other approved material. If let-in bracing is used, it shall be let into the top and bottom plates and the intervening studs, placed at not more than 60 degrees or less than 45 degrees from the horizontal and attached to the framing in conformance with Table 3606.2.3a. Structural sheathing and one-inch-by-four-inch (25 mm by 102 mm) let-in braces shall be installed in accordance with Table 3606.2.9 and fastened in accordance with Table 3606.2.3a.

**Exception:** The minimum 48-inch (1219 mm) braced wall panel width required by Table 3606.2.9 may be replaced by an alternate braced wall panel constructed in accordance with the following:

1. In one-story buildings, each panel shall have a width of not less than 32 inches (813 mm) and a height of not more than ten feet (3048 mm). Each panel shall be sheathed on one face with   -inch (9.5 mm) minimum thickness wood structural panel sheathing

**3606.2.7.1.2 Firestopping integrity:** The integrity of all firestops shall be maintained. nailed with 8d common or galvanized box nails in accordance with Table 3606.2.3a and blocked at all edges. Two anchor bolts installed in accordance with Figure 3604.3.1a or approved equivalent shear connectors shall be provided in each panel. Each panel end stud shall have a tie-down device fastened to the foundation, capable of providing an approved uplift capacity of not less than 1,800 pounds (816 kg). The tie-down device shall be installed in accordance with the manufacturer's recommendations. The panels shall be supported directly on a foundation or on floor framing supported directly on a foundation. This foundation or footing shall be continuous across the entire length of the braced wall line and shall be reinforced with not less than two No. 4 bars.

2. In the first story of two-story buildings, each braced wall panel shall be constructed in accordance with 780 CMR 3606.2.9 Exception item 1, except that the wood structural panel sheathing shall be applied to both faces, three anchor bolts or approved equivalent shear connectors shall be provided, and tie-down device uplift capacity shall not be less than 3,000 pounds (1361 kg).

## 780 CMR 3606.3 METAL

**3606.3.1 General:** *Metal structural elements in walls and partitions may be either hot-rolled structural shapes or bar sections or members cold formed to shape from sheet, strip or plate, or a fabricated combination thereof. Members shall be straight and free of any defects which would significantly affect their structural performance.*

*Structural elements in walls and partitions shall be constructed of materials and designed in accordance with AA SAA30, the AISI "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", as listed in Appendix A.*

## 780 CMR 3606.4 GENERAL MASONRY CONSTRUCTION

**3606.4.1 General:** Masonry construction shall be designed and constructed in accordance with the provisions of 780 CMR 3606.4 or in accordance with the provisions of ACI 530/ASCE 5/TMS 402, *as listed in Appendix A.*

TABLE 3606.2.9  
WALL BRACING

CONDITION <sup>1</sup>	TYPE OF BRACE	AMOUNT OF BRACING <sup>2,3</sup>
One story Top of two story or three story. First story of two story. Second Story.	One-inch-by-four-inch let in bracing or structural sheathing.	Located at each end and at least every 25 feet of wall length
First story of three story	Structural sheathing	Miminum 48-inch-wide panels. Located as required for let-in bracing.

- For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
1. Foundation wall panels braced same as story above.
  2. Where structural sheathing is used, each braced panel must be at least 48 inches in width.
  3. Structural sheathing and let-in bracing shall be located at each end or as near thereto as possible.

**3606.4.2 Thickness of masonry:** The nominal thickness of masonry walls shall conform to the requirements of **780 CMR 3606.4.2.1** through **3606.4.2.4**.

**3606.4.2.1 Minimum thickness:** The minimum thickness of masonry bearing walls more than one story in height shall be eight inches (203 mm). Solid masonry walls of one story dwellings and garages shall not be less than six inches (153 mm) in thickness when not greater than nine feet (2743 mm) in height, provided that when gable construction is used, an additional six feet (1829 mm) is permitted to the peak of the gable. Masonry walls shall be laterally supported in either the horizontal or vertical direction at intervals as required by **780 CMR 3606.4.8**.

**3606.4.2.2 Rubble stone masonry wall:** The minimum thickness of rough, random or coursed rubble stone masonry walls shall be 16 inches (406 mm).

**3606.4.2.3 Change in thickness:** *Masonry walls comprised of hollow units or of masonry bonded hollow units that decrease in thickness shall be constructed with a course of solid masonry between the wall below and the thinner wall above, or shall be constructed with special units or construction that shall transmit the loads from face shells or wythes above to those below.*

**3606.4.2.4 Parapet walls:** Unreinforced solid masonry parapet walls shall not be less than eight inches (203 mm) in thickness and the height of the parapet shall not exceed four times its thickness. Unreinforced hollow unit masonry parapet walls shall not be less than eight inches (203 mm) in thickness, and the height of the parapet shall not exceed three times its thickness.

**3606.4.3 Corbeled masonry:** Solid masonry units shall be used for corbeling. The maximum corbeled projection beyond the face of the wall shall not be more than ½ of the wall thickness or ½ the wythe thickness for hollow walls; the maximum projection

of one unit shall not exceed ½the height of the unit or \_ the thickness at right angles to the wall. The top course of corbels shall be a header course when the corbeled masonry is used to support floor or roof-framing members.

**3606.4.3.1 Support conditions:** Cavity wall or masonry veneer construction may be supported on an eight-inch (203 mm) foundation wall, provided the eight-inch (203 mm) wall is corbeled with solid masonry to the width of the wall system above. The total horizontal projection of the corbel shall not exceed two inches (51 mm) with individual corbels projecting not more than \_ the thickness of the unit or ½ the height of the unit. The top course of all corbels shall be a header course.

**3606.4.4 Allowable stresses:** Allowable compressive stresses in masonry shall not exceed the values prescribed in Table **3606.4.4**. In determining the stresses in masonry, the effects of all loads and conditions of loading and the influence of all forces affecting the design and strength of the several parts shall be taken into account.

**3606.4.4.1 Combined units:** In walls or other structural members composed of different kinds or grades of units, materials or mortars, the maximum stress shall not exceed the allowable stress for the weakest of the combination of units, materials and mortars of which the member is composed. The net thickness of any facing unit which is used to resist stress shall not be less than 1½ inches (38 mm).

**3606.4.5 Piers:** The unsupported height of masonry piers shall not exceed ten times the least dimension of the pier. When structural clay tile or hollow concrete masonry units are used for isolated piers to support beams and girders, the cellular spaces shall be filled solidly with concrete or Type M or S mortar. When hollow masonry units are solidly filled with concrete or Type M, S or N mortar, the

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allowable compressive stress may be increased as provided in Table 3606.4.4.

**3606.4.5.1 Pier cap:** Hollow piers shall be capped with four inches (102 mm) of solid masonry or concrete or the cavities of the top course shall be filled with concrete or grout or other methods approved by the building official.

**TABLE 3606.4.4  
ALLOWABLE COMPRESSIVE STRESSES  
FOR EMPIRICAL DESIGN OF MASONRY**

CONSTRUCTION; COMPRESSIVE STRENGTH OF UNIT, GROSS AREA	ALLOWABLE COMPRESSIVE STRESSES <sup>1</sup> GROSS CROSS- SECTIONAL AREA <sup>2</sup>	
	Type M or S Mortar	Type N Mortar
Solid masonry of brick and other solid units of clay or shale; sand lime or concrete brick: 8,000 + psi 4,500 psi 2,500 psi 1,500 psi	350 225 160 115	300 200 140 100
Grouted <sup>3</sup> masonry, of clay or shale; sand-lime or concrete: 4,500 psi 2,500 psi 1,500 psi	225 160 115	200 140 100
Solid masonry of solid concrete masonry units: 3,000 psi 2,000 psi 1,200 psi	225 160 115	200 140 100
Masonry of hollow load bearing units: 2,000 psi 1,500 psi 1,000 psi 700 psi	140 115 75 60	120 100 70 55
Hollow walls (cavity or masonry bounded <sup>4</sup> ) solid units: 2,500 psi 1,500 psi Hollow units	160 115 75	140 100 70
Stone ashlar masonry: Granits Limestone or marble Sandstone or cast stone	720 450 360	640 400 320
Rubble Stone Masonry: Coarse, rough or random	120	100

For SI: 1 psi = 6.895 kPa.

- 1. Linear interpolation shall be used for determining allowable stresses for masonry units having comprehensive strengths which are intermediate between those given in this table.
- 2. Gross cross-sectional area shall be calculated on the actual rather than nominal dimensions.
- 3. See 780 CMR 3606.7 Grouted Masonry.

**Exception:** Unfilled hollow piers may be used if the unsupported height of the pier is not more than four times its least dimension.

4. Where floor and roof loads are carried upon one wythe, the gross cross-sectional area is that of the wythe under load; if both wythes are loaded, the gross cross-sectional area is that of the wall minus the area of cavity between the wythes. Walls bonded with metal ties shall be considered as cavity walls unless the collar joints are filled with mortar or grout.

**3606.4.6 Chases:** Chases and recesses in masonry walls shall not be deeper than          the wall thickness, and the maximum length of a horizontal chase or horizontal projection shall not exceed four feet (1219 mm), and shall have at least eight inches (203 mm) of masonry in back of the chases and recesses and between adjacent chases or recesses and the jambs of openings. Chases and recesses in masonry walls shall be designed and constructed so as not to reduce the required strength or required fire resistance of the wall and in no case shall a chase or recess be permitted within the required area of a pier. Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on noncombustible lintels.

**3606.4.7 Stack bond:** In unreinforced masonry construction where units are laid in stack bond, longitudinal reinforcement consisting of not less than two continuous wires each with a minimum aggregate cross-sectional area of 0.017 square inches (11 mm<sup>2</sup>) shall be provided in horizontal bed joints spaced not more than 16 inches (406 mm) on center vertically.

**3606.4.8 Lateral support:** Masonry walls shall be laterally supported in either the horizontal or the vertical direction. The maximum spacing between lateral supports shall not exceed the distances allowed in Table **3606.4.8**. Lateral support shall be provided by cross walls, pilasters, buttresses, or structural frame members when the limiting distance is taken horizontally, or by floors or roofs when the limiting distance is taken vertically.

**3606.4.8.1 Horizontal lateral support:** Lateral support in the horizontal direction provided by intersecting masonry walls shall be provided by one of the methods defined in **780 CMR 3606.4.8.1.1** or **3606.4.8.1.2**.

**3606.4.8.1.1 Bonding pattern:** 50% of the units at the intersection shall be laid in an overlapping masonry bonding pattern, with alternate units having a bearing of not less than three inches (76 mm) on the unit below.

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**TABLE 3606.4.8**  
**SPACING OF LATERAL SUPPORT FOR**  
**MASONRY WALLS**

CONSTRUCTION	MAXIMUM WALL LENGTH TO THICKNESS OR WALL HEIGHT TO  THICKNESS <sup>1,2</sup>
Bearing Walls	20
Solid or solid grouted	18
All others	
Nonbearing walls	18
Exterior	36
Exterior	

For SI: 1 foot = 304.8 mm.

1. Except for cavity walls and cantilevered walls, the thickness of a wall shall be its nominal thickness measured perpendicular to the face of the wall. For cavity walls, the thickness shall be determined as the sum of the nominal thicknesses of the individual wythes. For cantilever walls, except for parapets, the ratio of the height to nominal thickness shall not exceed six for solid masonry, or four for hollow masonry. For parapets, see 780 CMR 3606.4.2.4.
2. An additional unsupported height of six feet is permitted for gable end walls.

**3606.4.8.1.2 Metal reinforcement:** Interior nonload-bearing walls shall be anchored at their intersections, at vertical intervals of not more than 16 inches (406 mm) with joint reinforcement of at least 9 gage, or ¼ inch (6.4 mm) galvanized mesh hardware cloth. Intersecting masonry walls, other than interior nonloadbearing walls, shall be anchored at vertical intervals of not more than eight inches (203 mm) with joint reinforcement of at least 9 gage and shall extend at least 30 inches (762 mm) in each direction at the intersection. Other metal ties, joint reinforcement or anchors, if used, shall be spaced to provide equivalent area of anchorage to that required by 780 CMR 3606.4.8.

**3606.4.8.2 Vertical lateral support:** Vertical lateral support of masonry walls shall be provided in accordance with one of the methods in 780 CMR 3606.4.8.2.1 or 3606.4.8.2.2.

**3606.4.8.2.1 Roof structures:** Masonry walls shall be anchored to roof structures with metal strap anchors, ½-inch (12.7 mm) bolts, or other approved anchors spaced not more than six feet (1829 mm) on center. Anchors shall be embedded at least 16 inches (406 mm) into the masonry, or be hooked or welded to bond beam reinforcement placed not less than six inches (153 mm) from the top of the wall.

**3606.4.8.2.2 Floor diaphragms:** Masonry walls shall be anchored to floor diaphragms at intervals not to exceed six feet (1829 mm). Support shall be provided by metal strap

anchors or ½-inch-diameter (12.7 mm) bolts installed as shown in Figure 3606.4.10a, or by other approved methods.

**3606.4.9 Lintels:** Masonry over openings shall be supported by steel lintels, reinforced concrete or masonry lintels or masonry arches, designed to support load imposed.

**3606.4.10 Anchorage.** Masonry walls shall be anchored to floor and roof systems in accordance with the details shown in Figure 3606.4.10a, 3606.4.10b or 3606.4.10c. Footings may be considered as points of lateral support.

**3606.4.11 Reinforcement:** Masonry walls subject to wind loads of 30 pounds per square foot (1.44 kN/m²) or greater, shall be constructed in accordance with the requirements of 780 CMR 3606.4.11 and Figures 3606.4.10b and 3606.4.10c. In addition, the minimum area of reinforcement shall not be less than 0.002 times the gross cross-sectional area of the wall, not more than \_ of which may be used in either direction. No required vertical reinforcement shall be less than \_ inch (9.5 mm) in diameter. Principal wall reinforcement shall have a maximum spacing of four feet (1219 mm) on center.

**3606.4.12 Protection for reinforcement:** All bars shall be completely embedded in mortar or grout. Joint reinforcement embedded in horizontal mortar joints shall not have less than \_-inch (15.9 mm) mortar coverage from the exposed face. All other reinforcement shall have a minimum coverage of one bar diameter over all bars, but not less than ¾ inch (19 mm). Where exposed to weather or soil, the minimum coverage shall be two inches (51 mm).

**3606.4.13 Beam supports:** Beams, girders or other concentrated loads supported by a wall or column shall have a bearing of at least three inches (76 mm) in length measured parallel to the beam upon solid masonry not less than four inches (102 mm) in thickness, or upon a metal bearing plate of adequate design and dimensions to distribute the load safely, or upon a continuous reinforced masonry member projecting not less than four inches (102 mm) from the face of the wall.

**3606.4.13.1 Joist bearing:** Joists shall have a bearing of not less than 1½ inches (38 mm), except as provided in 780 CMR 3606.4.13, and shall be supported in accordance with Figures 3606.4.10b and 3606.4.10c.

**3606.4.14 Metal accessories:** Joint reinforcement, anchors, ties and wire fabric shall conform to the following *reference standards as listed in Appendix A*: ASTM A 82 for joint reinforcement, wire anchors and ties; ASTM A 36 for plate, headed

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and bent-bar anchors; ASTM A 510 for corrugated  
sheet metal anchors and ties; ASTM B 227 for

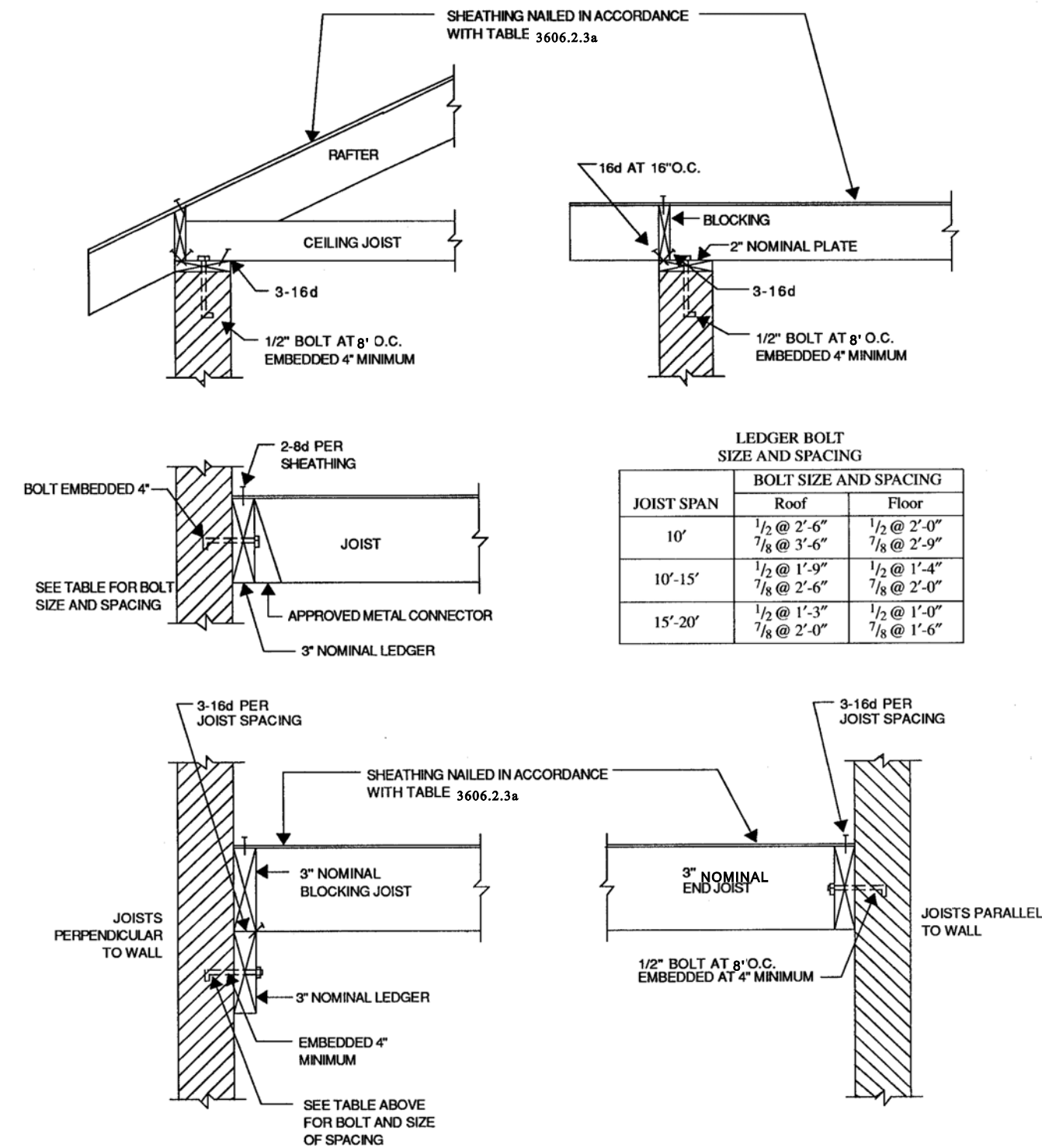
copper-clad steel wire ties or ASTM A 167 for  
stainless steel hardware.

**3606.4.14.1 Corrosion protection:** Minimum corrosion protection of joint reinforcement, anchor ties and wire fabric for use in masonry wall construction shall conform to Table **3606.4.14.1**.

**TABLE 3606.4.14.1  
MINIMUM CORROSION PROTECTION**

MASONRY METAL ACCESSORY	STANDARD
Joint reinforcement, interior walls	ASTM A 641, Class 1
Wire ties or anchors in exterior walls completely embedded in mortor or grout	ASTM A 641, Class 3
Wire ties or anchors in exterior walls not completely embedded in mortor or grout	ASTM A 153, Class B-2
Joint reinforcement in exterior walls or interior walls exposed to moist environment	ASTM A 153, Class B-2
Sheet metal ties or anchors exposed to weather	ASTM A 153, Class B-2
Sheet metal ties or anchors completely embedded in mortar or grout	ASTM A 525, Class G-60
Stainless steel hardware for any exposure	ASTM A 167, Type 304

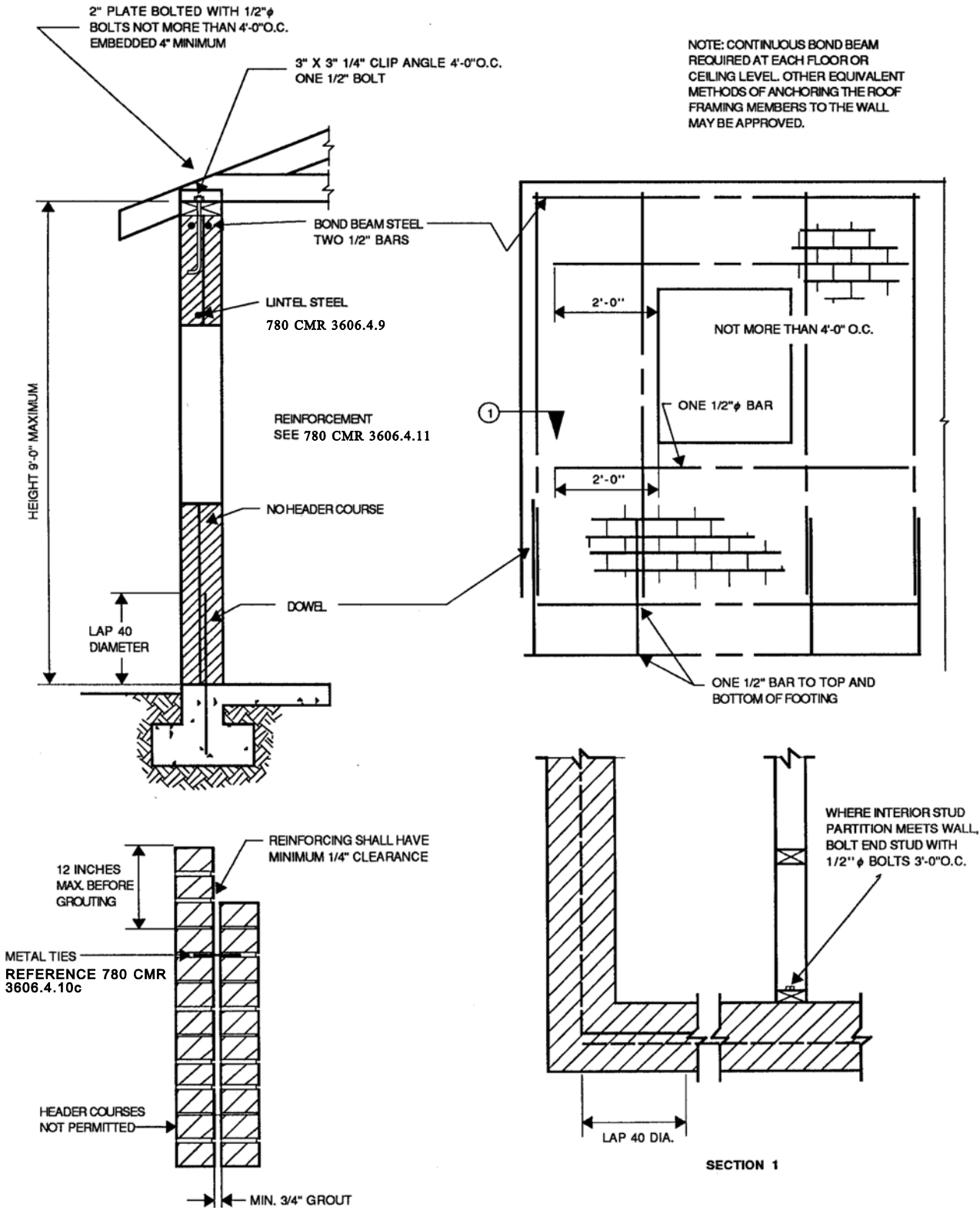
FIGURE 3606.4.10a  
ANCHORAGE REQUIREMENTS FOR MASONRY WALLS



WHERE BOLTS ARE LOCATED IN HOLLOW MASONRY, THE CELLS IN THE COURSES RECEIVING THE BOLTS SHALL BE GROUTED SOLID.

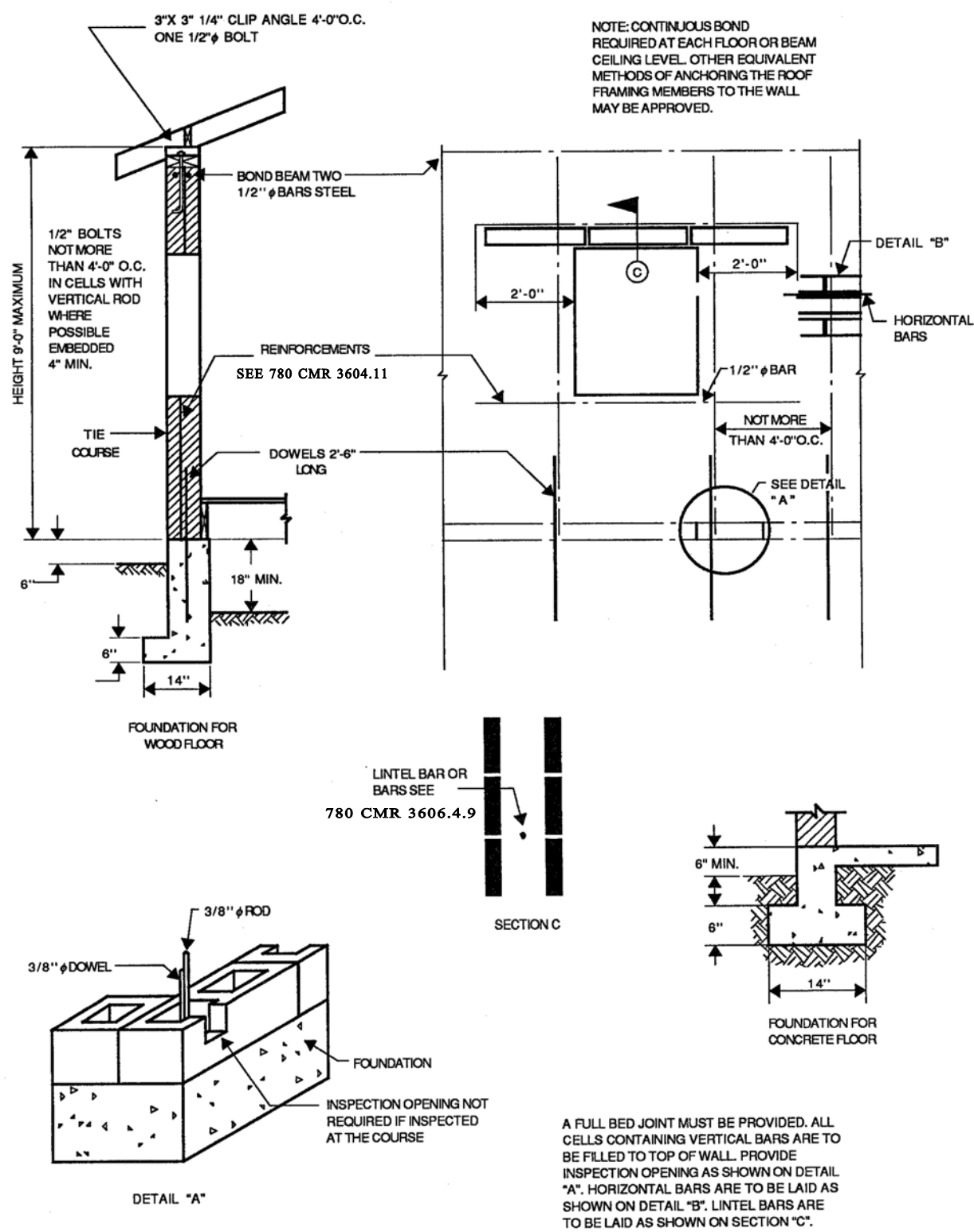
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.0479 kN/m<sup>2</sup>

**FIGURE 3606.4.10b**  
**REQUIREMENTS FOR REINFORCED GROUTED MASONRY CONSTRUCTION**  
**WHERE WIND LOADS ARE 30 PSF OR GREATER**



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.0479 kN.m<sup>2</sup>.

**FIGURE 3606.4.10c**  
**REQUIREMENTS FOR REINFORCED HOLLOW-UNIT MASONRY CONSTRUCTION**  
**WHERE WIND LOADS ARE 30 PSF OR GREATER**



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.0479 kN/m<sup>2</sup>.



**780 CMR 3606.5 UNIT MASONRY****3606.5.1 Placing mortar and masonry units:**

**3606.5.1.1 Bed and head joints:** Unless otherwise required or indicated on the project drawings, head and bed joints shall be    inch (9.5 mm) thick, except that the thickness of the bed joint of the starting course placed over foundations shall not be less than ¼ inch (6.4 mm) and not more than ¾ inch (19 mm).

**3606.5.1.1.1 Mortar joint thickness tolerance:** Mortar joint thickness shall be within the following tolerances from the specified dimensions:

bed joint.....±    inch (3.2 mm)  
head joint.....-¼ inch (6.4 mm), +    inch (9.5 mm)  
collar joints..... -¼ inch (6.4 mm), +    inch (9.5 mm)

**Exception:** Nonload-bearing masonry elements and masonry veneers designed and constructed in accordance with **780 CMR 3607.3.7** are not required to meet these tolerances.

**3606.5.1.2 Masonry unit placement:** The mortar shall be sufficiently plastic and units shall be placed with sufficient pressure to extrude mortar from the joint and produce a tight joint. Deep furrowing of bed joints which produces voids shall not be permitted. Any units disturbed to the extent that the initial bond is broken after initial placement shall be removed and relaid in fresh mortar. Surfaces to be in contact with mortar shall be clean and free of deleterious materials.

**3606.5.1.2.1 Solid masonry:** All solid masonry units shall be laid with full head and bed joints and all interior vertical joints that are designed to receive mortar shall be filled solid.

**3606.5.1.2.2 Hollow masonry:** *All head and bed joints of hollow masonry units shall be filled solidly with mortar. The mortar shall extend a distance from the face of the masonry unit that shall measure not less than the thickness of the face shell.*

**3606.5.2 Installation of wall ties:** The installation of wall ties shall be as follows:

1. The ends of wall ties shall be embedded in mortar joints. Wall tie ends shall engage outer face shells of hollow units by at least ½ inch (12.7 mm). Wire wall ties shall be embedded at least 1½ inches (38 mm) into the mortar bed of solid masonry units or solid grouted hollow units.

**3606.6.1.2.1 Bonding with wall ties:** Bonding with wall ties, except as required by **780 CMR**

2. Wall ties shall not be bent after being embedded in grout or mortar.

**780 CMR 3606.6 MULTIPLE WYTHER MASONRY**

**3606.6.1 General:** The facing and backing of multiple wythe masonry walls shall be bonded in accordance with **780 CMR 3606.6.1.1, 3606.6.1.2 or 3606.6.1.3**. In cavity walls, neither the facing nor the backing shall be less than three inches (76 mm) nominal in thickness and the cavity shall not be more than four inches (102 mm) nominal in width. The backing shall be at least as thick as the facing.

**Exception:** Cavities may exceed the four-inch (102 mm) nominal dimension provided tie size and tie spacing have been established by calculation.

**3606.6.1.1 Bonding with masonry headers:** Bonding with solid or hollow masonry headers shall comply with **780 CMR 3606.6.1.1.1 and 3606.6.1.1.2**.

**3606.6.1.1.1 Solid units:** Where the facing and backing (adjacent wythes) of solid masonry construction are bonded by means of masonry headers, no less than 4% of the wall surface of each face shall be composed of headers extending not less than three inches (76 mm) into the backing. The distance between adjacent full-length headers shall not exceed 24 inches (610 mm) either vertically or horizontally. In walls in which a single header does not extend through the wall, headers from the opposite sides shall overlap at least three inches (76 mm), or headers from opposite sides shall be covered with another header course overlapping the header below at least three inches (76 mm).

**3606.6.1.1.2 Hollow units:** Where two or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals not exceeding 34 inches (864 mm) by lapping at least three inches (76 mm) over the unit below, or by lapping at vertical intervals not exceeding 17 inches (432 mm) with units which are at least 50% greater in thickness than the units below.

**3606.6.1.2 Bonding with wall ties or joint reinforcement:** Bonding with wall ties or joist reinforcement shall comply with **780 CMR 3606.6.1.2.1 through 3606.6.1.2.3**.

**3606.6.1.2.2**, where the facing and backing (adjacent wythes) of masonry walls are bonded

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with  $\frac{3}{16}$ -inch-diameter (4.8 mm) wall ties embedded in the horizontal mortar joints, there shall be at least one metal tie for each  $4\frac{1}{2}$  square feet ( $0.418 \text{ m}^2$ ) of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance between ties shall not exceed 24 inches (610 mm), and the maximum horizontal distance shall not exceed 36 inches (914 mm). Rods or ties bent to rectangular shape shall be used with hollow masonry units laid with the cells vertically. In other walls, the ends of ties shall be bent to 90-degree angles to provide hooks no less than two inches (51 mm) long. Additional bonding ties shall be provided at all openings, spaced not more than three feet (914 mm) apart around the perimeter and within 12 inches (305 mm) of the opening.

**3606.6.1.2.2 Bonding with adjustable wall ties:** Where the facing and backing (adjacent wythes) of masonry are bonded with adjustable wall ties, there shall be at least one tie for each 2 square feet ( $0.248 \text{ m}^2$ ) of wall area. Neither the vertical nor horizontal spacing of the adjustable wall ties shall exceed 24 inches (610 mm). The maximum vertical offset of bed joints from one wythe to the other shall be  $1\frac{1}{4}$  inches (32 mm). The maximum clearance between connecting parts of the ties shall be  $\frac{1}{16}$  inch (1.6 mm). When pintle legs are used, ties shall have at least two  $\frac{3}{16}$ -inch-diameter (4.8 mm) legs.

**3606.6.1.2.3 Bonding with prefabricated joint reinforcement:** Where the facing and backing (adjacent wythes) of masonry are bonded with prefabricated joint reinforcement, there shall be at least one cross wire serving as a tie for each 2 square feet ( $0.248 \text{ m}^2$ ) of wall area. The vertical spacing of the joint reinforcement shall not exceed 16 inches (406 mm). Cross wires on prefabricated joint reinforcement shall not be smaller than No. 9 gage. The longitudinal wires shall be embedded in the mortar.

**3606.6.1.3 Bonding with natural or cast stone:** Bonding with natural and cast stone shall conform to **780 CMR 3606.6.1.3.1** and **3606.6.1.3.2**.

**3606.6.1.3.1 Ashlar masonry:** Bonder units in ashlar masonry that are uniformly distributed, shall be provided to the extent of not less than 10% of the wall area. Such bonder units shall

extend not less than four inches (102 mm) into the backing wall.

**3606.6.1.3.2 Rubble stone masonry:** Rubble stone masonry 24 inches (610 mm) or less in thickness shall have bonder units with a maximum spacing of three feet (914 mm) vertically and three feet (914 mm) horizontally, and if the masonry is of greater thickness than 24 inches (610 mm), shall have one bonder unit for each six square feet ( $0.557 \text{ m}^2$ ) of wall surface on both sides.

**3606.6.2 Masonry bonding pattern:** Masonry laid in running and stack bond shall conform to **780 CMR 3606.6.2.1** and **3606.6.2.2**.

**3606.6.2.1 Masonry laid in running bond:** In each wythe of masonry laid in running bond, head joints in successive courses shall be offset by not less than one-fourth the unit length, or the masonry walls shall be reinforced longitudinally as required in **780 CMR 3606.6.2.2**.

**3606.6.2.2 Masonry laid in stack bond:** Where unit masonry is laid with less head joint offset than in **780 CMR 3606.6.2.1**, the minimum area of horizontal reinforcement placed in mortar bed joints or in bond beams spaced not more than 48 inches (1219 mm) apart, shall be 0.0007 times the vertical cross-sectional area of the wall.

## 780 CMR 3606.7 GROUTED MASONRY

**3606.7.1 General:** Grouted multiple-wythe masonry is a form of construction in which the space between the wythes is solidly filled with grout. It is not necessary for the cores of masonry units to be filled with grout. Grouted hollow unit masonry is a form of construction in which certain cells of hollow units are continuously filled with grout.

**3606.7.1.1 Mortar and grout:** Only Type M or Type S mortar mix consisting of portland cement, hydrated lime and sand in accordance with ASTM C 270, *listed in Appendix A*, and the proportion specifications of Table **3606.7.1.1a** shall be used to construct masonry wythes. Grout shall consist of cementitious material and aggregate in accordance with ASTM C 476, *listed in Appendix A*, and the proportion specifications of Table **3606.7.1.1b**. Type M or Type S mortar to which sufficient water has been added to produce pouring consistency can be used as grout.

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TABLE 3606.7.1.1a  
MORTAR PROPORTIONS<sup>1,2</sup>

PROPORTIONS BY VOLUME (Cementitious Materials)						
Mortar	Type	Protland Cement or Blended Cement	Masonry Cement			Hydrated Lime or Lime Putty
			M	S	N	
Cement-lime	M	1	-	-	-	1/4
	S	1	-	-	-	over 1/4 to 1/2
	N	1	-	-	-	over 1/2 to 1 1/4
	O	1	-	-	-	over 1 1/4 to 2 1/2
Masonry cement	M	1	-	-	1	Not less than 2/4 and not more than three times the sum of separate volumes of lime, if used, and cement
	M	-	1	-	-	
	S	1/2	-	-	1	
	S	-	-	1	-	
	N	-	-	-	1	
	O	-	-	-	1	

- For Sl: 1 cubic foot = 0.0283 m<sup>3</sup>, 1 pound = 0.454 kg.
1. For the purpose of these specifications, the weight of one cubic foot of the respective materials shall be considered to be as follows:
- Portland Cement94 lb.
  - Masonry cementWeight printed on bag
  - Hydrated lime40 lb.
  - Lime putty(quicklime)80 lb.
  - Sand, damp and loose80 lb. of dry sand
2. Two air-entraining materials shall not be combined in mortar.

TABLE 3606.7.1.1b  
GROUT PROPORTIONS BY VOLUME FOR MASONRY CONSTRUCTION

TYPE	PORTLAND CEMENT OR BLENDED CEMENT SLAG CEMENT	HYDRATED LIME OR LIME PUTTY	AGGREGATE MEASURED IN A DAMP, LOOSE CONDITION	
			Fine	Coarse
Fine	1	0 to 1/10	2 1/4 to three times the sum of the volume of the cementitious materials	-
Coarse	1	0 to 1/10	2 1/4 to three times the sum of the volume of the cementitious materials	One to two times the sum of the volumes of the cementitious materials

**3606.7.1.2 Grouting requirements:** Maximum pour heights and the minimum dimensions of spaces provided for grout placement shall conform to Table **3606.7.1.2**. If the work is stopped for one hour or longer, the horizontal construction joints shall be formed by stopping all tiers at the same elevation and with the grout one inch (25 mm) below the top.

TABLE 3606.7.1.2  
GROUT SPACE DIMENSIONS AND  
POUR HEIGHTS

GROUT TYPE	GROUT POUR MAXIMUM HEIGHT (feet)	MINIMUM WIDTH OF GROUT SPACES <sup>1,2</sup> (inches)	MINIMUM GROUT <sup>2,3</sup> SPACE DIMENSIONS FOR GROUTING CELLS OF HOLLOW UNITS (inches = 43 inches)
Fine	1	3/4	1 1/2 x 2
	5	2	2 x 3
	12	2 1/2	2 1/2 x 3
	24	3	3 x 3
Coarse	1	1 1/2	1 1/2 x 3
	5	2	2 1/2 x 3
	12	2 1/2	3 x 3

	24	3	3 x 4
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- For Sl: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
1. For grouting between masonry wythes.
2. Grout space dimension is the clear dimension between any masonry protrusion and shall be increased by the horizontal projection of the diameters of the horizontal bars within the cross section of the grout space.
3. Area of vertical reinforcement shall not exceed 6% of the area of the grout space.

**3606.7.1.3 Grout space (cleaning):** Provision shall be made for cleaning grout space. Mortar projections which project more than 1/2 inch (12.7 mm) into grout space and any other foreign matter shall be removed from grout space prior to inspection and grouting.

**3606.7.1.4 Grout placement:** Grout shall be a plastic mix suitable for pumping without segregation of the constituents and shall be mixed thoroughly. Grout shall be placed by pumping or by an approved alternate method and shall be

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placed before any initial set occurs and in no case more than 1½ hours after water has been added. Grouting shall be done in a continuous pour, in lifts not exceeding four feet (1219 mm). It shall be consolidated by puddling or mechanical vibrating during placing and reconsolidated after excess moisture has been absorbed but before plasticity is lost.

**3606.7.1.4.1 Grout pumped through aluminum pipes:** Grout shall not be pumped through aluminum pipes.

**3606.7.1.5 Cleanouts:** Where required by the building official, cleanouts shall be provided as specified in 780 CMR 3606.7.1.5. The cleanouts shall be sealed before grouting and after inspection.

**3606.7.1.5.1 Grouted multiple-wythe masonry:** Cleanouts shall be provided at the bottom course of the exterior wythe at each pour of grout where such pour exceeds five feet (1524 mm) in height.

**3606.7.1.5.2 Grouted hollow unit masonry:** Cleanouts shall be provided at the bottom course of each cell to be grouted at each pour of grout, where such pour exceeds four feet (1219 mm) in height.

**3606.7.1.6 Inspection:** Special inspection during grouting shall be provided where required by the building official.

**3606.7.2 Grouted multiple-wythe masonry:** Grouted multiple-wythe masonry shall conform to all the requirements specified in **780 CMR 3606.7.1** and the requirements of 780 CMR 3606.7.2.

**3606.7.2.1 Bonding of backup wythe:** Where all interior vertical spaces are filled with grout in multiple-wythe construction, masonry headers shall not be permitted. Metal wall ties shall be used in accordance with **780 CMR 3606.6.1.2** to prevent spreading of the wythes and to maintain the vertical alignment of the wall. Wall ties shall be installed in accordance with **780 CMR 3606.6.1.2**, when the backup wythe in multiple-wythe construction is fully grouted.

**3606.7.2.2 Grout spaces:** Fine grout shall be used when interior vertical space to receive grout does not exceed two inches (51 mm) in thickness. Interior vertical spaces exceeding two inches (51 mm) in thickness shall use coarse or fine grout.

**3606.7.2.3 Grout barriers:** Vertical grout barriers or dams shall be built of solid masonry across the grout space the entire height of the wall to control the flow of the grout horizontally.

Grout barriers shall not be more than 25 feet (7620 mm) apart. The grouting of any section of a wall between control barriers shall be completed in one day with no interruptions greater than one hour.

**3606.7.3 Reinforced grouted multiple-wythe masonry:** Reinforced grouted multiple-wythe masonry shall conform to all the requirements specified in **780 CMR 3606.7.1** and **3606.7.2** and the requirements of 780 CMR 3606.7.3

**3606.7.3.1 Construction:** The thickness of grout or mortar between masonry units and reinforcement shall not be less than ¼ inch (6.4 mm), except that ¼-inch (6.4 mm) bars may be laid in horizontal mortar joints at least ½ inch (12.7 mm) thick, and steel wire reinforcement may be laid in horizontal mortar joints at least twice the thickness of the wire diameter.

**3606.7.4 Reinforced hollow unit masonry:** Reinforced hollow unit masonry shall conform to all the requirements of **780 CMR 3606.7.1** and the requirements of 780 CMR 3606.7.4.

**3606.7.4.1 Construction:** Requirements for construction shall be as follows:

1. All reinforced hollow-unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full-bedded in mortar to prevent leakage of grout. All head and end joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells. Bond shall be provided by lapping units in successive vertical courses.
2. Cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell of dimensions prescribed in Table **3606.7.1.2**.
3. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 200 diameters of the reinforcement.
4. All cells containing reinforcement shall be filled solidly with grout. Grout shall be poured in lifts of eight-foot (2438 mm) maximum height. When total grout pour exceeds eight feet (2438 mm) in height, the grout shall be placed in lifts not exceeding four feet (1219 mm) and special inspection during grouting shall be required.
5. Horizontal steel shall be fully embedded by grout in an uninterrupted pour.

**780 CMR 3606.8 WINDOWS**

**3606.8.1 Testing and certification:** Windows shall be tested and certified to indicate compliance with the requirements of the following specifications:

Aluminum: AAMA (ANSI) 101

**3606.8.2 Air infiltration:** Regardless of the type or requirements of the windows set forth in the aforementioned specifications, no window may be selected whose air infiltration exceeds 0.50 cubic feet per minute per linear foot (0.236 L/s per mm) of crack when tested in accordance with ASTM E 283, *as listed in Appendix A*, at a pressure differential of 1.56 psf (0.075 kN/m<sup>2</sup>).

## 780 CMR 3606.9 SLIDING GLASS DOORS

**3606.9.1 Testing and certification:** Sliding glass doors shall be tested and certified to indicate compliance with the requirements of the following specifications:

Aluminum: AAMA (ANSI) 101

Wood: ANSI/NWWDA I.S.3, *each as listed in Appendix A*.

**3606.9.2 Air infiltration:** Regardless of the type or requirements of the sliding glass doors set forth in the aforementioned specifications, no sliding glass door may be selected whose air infiltration exceeds 0.50 cubic feet per minute per square foot (0.236 L/s per mm<sup>2</sup>) of door area when tested in accordance with ASTM E 283, *as listed in Appendix A*, at a pressure differential of 1.56 pounds per square foot (0.075kN/m<sup>2</sup>).

Wood: ANSI/NWWDA I.S. 2

Polyvinyl Chloride: ASTM D 4099, *each as listed in Appendix A*.

## 780 CMR 3606.10 PLYWOOD AND WOOD STRUCTURAL PANELS

**3606.10.1 Identification and grade:** Plywood shall conform to DOC PS 1, DOC PS 2 or HPMA (ANSI) HP, *as listed in Appendix A*. Wood structural panels shall conform to DOC PS 2, *as listed in Appendix A*. All panels shall be identified by a grade mark or certificate of inspection issued by an approved agency. Wood structural panels shall comply with the grades specified in Table **3606.2.3b**.

**3606.10.2 Allowable spans:** The maximum allowable spans for wood structural panel wall sheathing shall not exceed the values set forth in Table **3606.2.3b**.

**3606.10.3 Installation:** Wood structural panel wall sheathing shall be attached to framing in accordance with Table **3606.2.3a**. Wood structural panels marked Exposure 1 or Exterior are considered water-repellent sheathing under 780 CMR.

## 780 CMR 3606.11 PARTICLEBOARD

**3606.11.1 Identification and grade:** Particleboard shall conform to ANSI A208.1, *as listed in Appendix A*, and shall be so identified by a grade mark or certificate of inspection issued by an approved agency. Particleboard shall comply with the grades specified in Table **3606.2.3c**.